The *Intritacalx*, an Undescribed Shell Layer in Mollusks

BY

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(1 Plate; 1 Text figure)

IN THE COURSE OF WORK on the taxonomy and evolution of muricid gastropods, we have noted a peculiar feature of the shell surface. It differs from the underlying shell in being flat white in color, much softer, and, in many cases, with intricate sculpture which may not correspond to that of the underlying shell. For this surface layer we have coined the term **intritacalx**, a name which reflects some of the unique features of this structure: intrita - crumbly; calx - chalk.

A great deal of work has been done on the deposition and mineralogy of molluscan shells (BØGGILD, 1930; CLARK & WHEELER, 1922; TRAVIS, FRANÇOIS, BONAR & GLIMCHER, 1967; TAYLOR & KENNEDY, 1969; KENNEDY, TAYLOR & HALL, 1969). In none of these papers, nor in any pertinent secondary references on the subject, have we found any comment which indicates an awareness of this surface layer.

A few of the malacologists who have studied the Muricidae and were aware of this structure have made only cursory mention of a peculiar color, texture, or microsculpture (HARRY, 1969; KEEN, 1958; KURODA, 1953; MCLEAN & EMERSON, 1970; VOKES, 1970). Some authors have commented that species of *Aspella* were generally "... worn-looking but had bright underlying color patterns." They apparently did not realize that the specimens in question had the intritacalx partially worn away, and that the bright color pattern was in the underlying shell. Other workers were under the misapprehension that the white, limy coating was an extraneous encrustation or deposit, or due to deterioration of the shell from weathering. Although the intritacalx occurs most frequently in the Muricidae, it is also present in other gastropod and in bivalve groups.

The differences between the intritacalx and the underlying shell suggested that its chemical or physical nature might differ from typical molluscan shell matter. Results of X-ray diffraction tests showed that chemically the intritacalx is made up of calcium carbonate ($CaCO_3$), essentially indistinguishable from the typical molluscan shell. Physically the intritacalx is composed of varying proportions of aragonite and calcite, the two crystalline forms of calcium carbonate found in mollusk shells. The relative amount of aragonite and calcite in the intritacalx of a given shell is in the same proportion as that of the underlying shell (Figure 1). The hardness of molluscan shells is principally dependent on the presence and amount of organic binding material, termed conchiolin. Presumably, the softness of the intritacalx is due to a sparsity of conchiolin (TRAVIS & GONSALVES, 1969).

We have studied the intritacalx in 4 families of gastropods (Muricidae, Bursidae, Cancellariidae, Turritellidae) and two families of bivalves (Mactridae, Pholadidae). In most instances it is deposited in the form of simple axial growth striae, differing from the underlying shell only in hardness and color. Where the intritacalx is deposited in axial lamellae, it is not only softer than the underlying shell but also may not correspond to the shell sculpture underlying it. The most unusual form taken by the intritacalx is found in the genera *Aspella, Typhisopsis, Tripterotyphis,* and related groups, and in the Bursidae. In these groups it is deposited in intricate patterns which are either much exaggerated reflections of the sculpture of the shell beneath it or are completely unrelated to it. The patterns are commonly reticulate, as in *Dermomurex* and *Bursa* (Figures 6, 8), but other, more complex patterns are found in other groups (e.g. *Aspella, Typhisopsis*).

In *Typhisopsis coronata* (Broderip, 1833) (Figure 7), the intritacalx is laid down as growth striae. In the most recently deposited section, the layer is continuous and uninterrupted. At a slightly earlier point in the growth of

Dermomurex obeliscus (A. Adams, 1851)

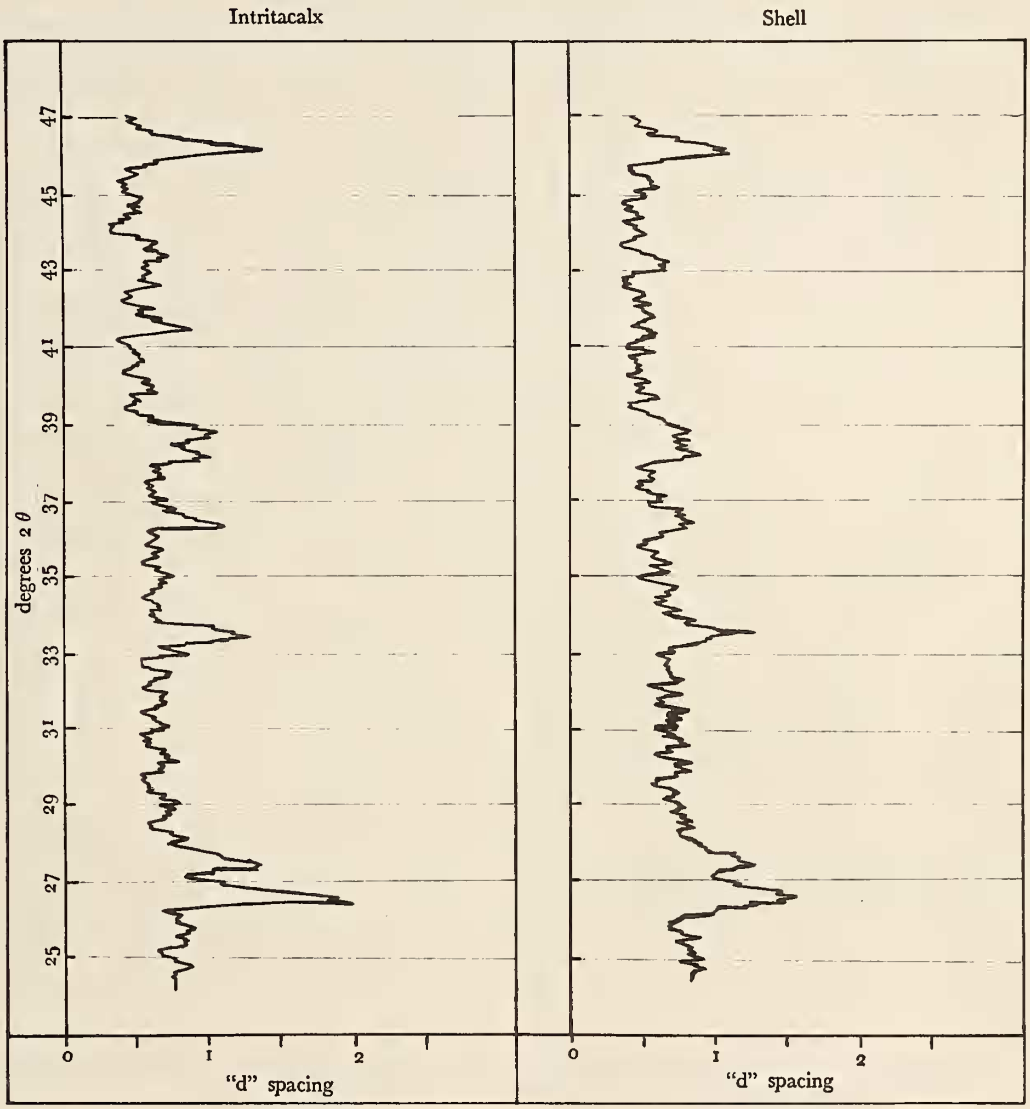

Figure 1

Dermomurex obeliscus (A. Adams, 1851)
X-ray diffraction patterns of the shell and intritacalx

the shell, shortly behind the outer apertural lip, roughly semicircular depressions are found, most deeply imprinted opposite to the direction of growth. These depressions are sparsely and randomly scattered over the surface. The density of these features increases toward the earlier whorls until, on the third or fourth whorl previous to the growing edge, the entire surface is covered with depressions. The pattern may occur throughout the genus, but sufficient material has not been available to investigate this possibility.

In *Tripterotyphis lowei* (Pilsbry, 1932) (Figure 2) the intritacalx is deposited in the form of numerous scalloped or frilled laminae covering the entire shell surface. The embayments in the scalloped edges are raised from the surface and the projections are appressed to the shell. There are also comparatively large pits in a single row, aligned with each varix, imparting the appearance of a coarsely stitched seam to the postvarical area.

Another, more intricate type of intritacalx is found in the Panamic *Aspella* sp. (*cf. A. pyramidalis* (Broderip, 1833)) (Figure 4) and in several other species of *Aspella*. Under low magnification there appears to be a pattern of exceedingly fine axial grooves. Under higher magnification (100×) the grooves can be seen to be lined with pits which appear as tunnel openings. These openings seem to penetrate the intritacalx at a shallow angle. The tunnels do not extend as far as the next axial groove in the direction of growth.

In *Gracilimurex bakeri* (Hertlein & Strong, 1951) (Figure 5) and *Takia inermis* (Sowerby, 1841) the intritacalx is laid down as axial growth striae with broad, shallow, wide-spaced, spiral depressions crossing them. A specimen with a partially eroded surface shows that the intritacalx erodes more noticeably in these depressed areas. When a section at right angles to the direction of growth is viewed, it is apparent that the intritacalx is undermined with tunnels following the spiral sculpture. The intritacalx between the spiral furrows is continuous from its outer surface to the shell below and thus erosion in this region is not as quickly evident.

A simpler form of intritacalx is found in the genera *Calotrophon* and *Favartia* (Figure 3). The chalky surface here is deposited in the form of lamellae, best developed in the shoulder region. The surface is unrelated to the sculptural elements of the underlying shell.

The simplest form of intritacalx is found in *Austrotrophon, Boreotrophon, Maxwellia, Poirieria, Turritella, Cancellaria,* and other genera. In all of these groups we have found the intritacalx occurring as a series of simple growth striae following the periodic increments of the underlying shell. In species in these and other groups we have, on many occasions, found the intritacalx underneath a thin, yellow, parchment-like periostracum.

In conclusion, we believe that the intritacalx is of potentially great taxonomic importance in the groups in which it occurs. This is particularly true in the genera *Aspella, Dermomurex, Typhisopsis* and *Tripterotyphis*. In each of these groups the sculpture of the intritacalx is characteristic and constant. It is also of value at the species level, especially in *Aspella*. In this genus, species from widely separated geographical regions have often been confused and considered conspecific on the basis of worn shells. The distinctive details of the intritacalx of *Aspella* species are helpful in separating them.

On the basis of the foregoing we suggest that:

1: As the intritacalx is mineralogically similar to or identical with the underlying shell, its softness is probably due to a sparsity of organic binding matter.

2: Since the shell is deposited by the mantle, it is not unreasonable to assume that the intritacalx is also laid down by the mantle.

3: We believe that the intritacalx is deposited synchronously with the underlying shell, an assumption strengthened by its deposition, in many cases, immediately under a periostracum.

The intricacy of pattern and structure (as in those species whose intritacalx is undermined with tunnels) may prove of interest in determining the possible functional morphology of this chalky surface layer.

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Plate Explanation

Intritacalx Patterns – Schematic Representation

Figure 2: *Tripterotyphis lowei* (Pilsbry, 1931) – normal view ca. 800×

Figure 3: *Calotrophon ostrearum* (Conrad, 18?) – composite view normal and cross-sectional ca. 50×

Figure 4: *Aspella* cf. *A. pyramidalis* (Broderip, 1833) – normal views upper: 630×; lower: 900×

Figure 5: *Gracilimurex bakeri* (Hertlein & Strong, 1951) – Composite view, normal and cross-sectional ca. 70×

Figure 6: *Dermomurex obeliscus* (A. Adams, 1851) – normal view ca. 200×

Figure 7: *Typhisopsis coronata* (Broderip, 1833) – normal views left: ca. 125×; right: ca. 75×

Figure 8: *Bursa calcipicta* Dall, 1908 – normal view, ca. 85×

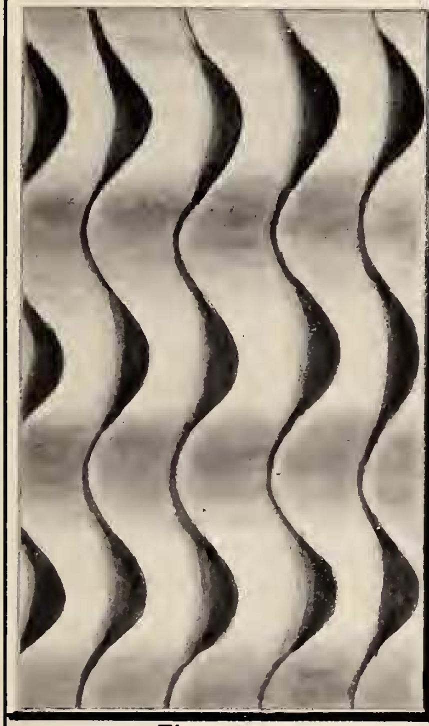

Figure 2

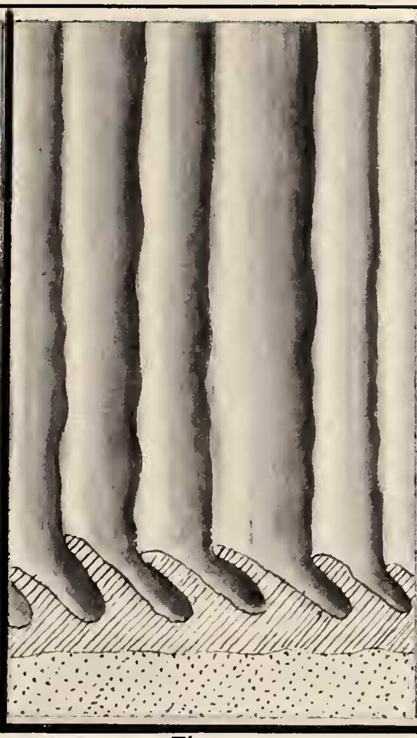

Figure 3

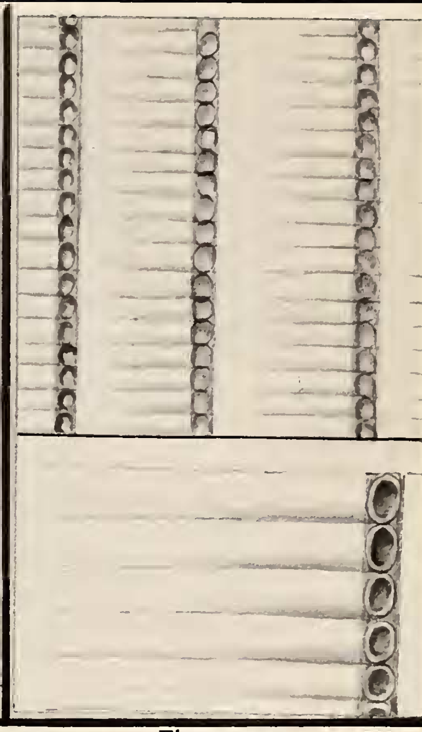

Figure 4

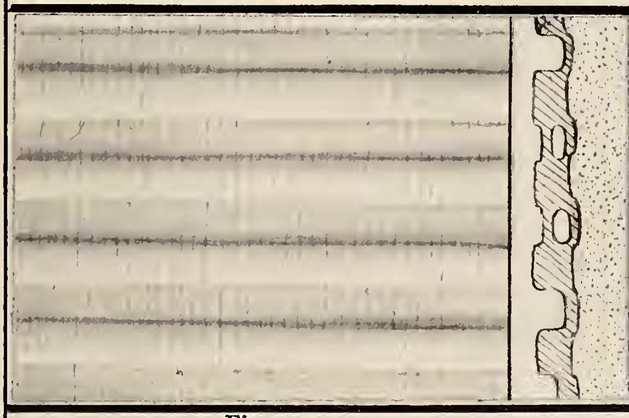

Figure 5

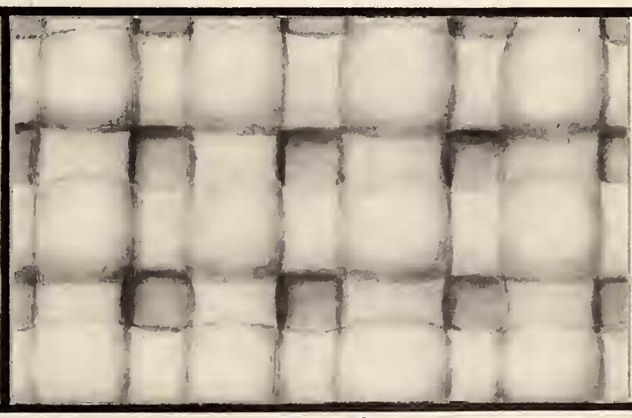

Figure 6

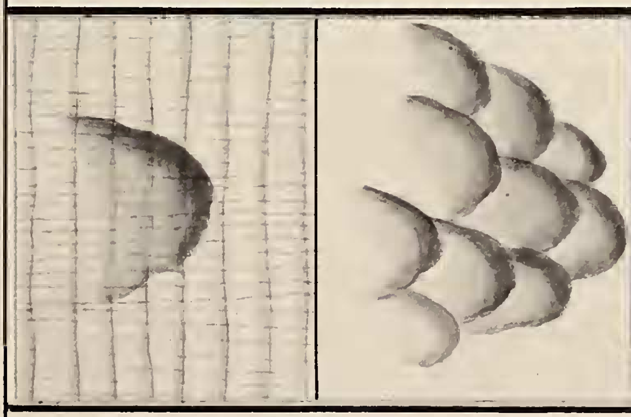

Figure 7

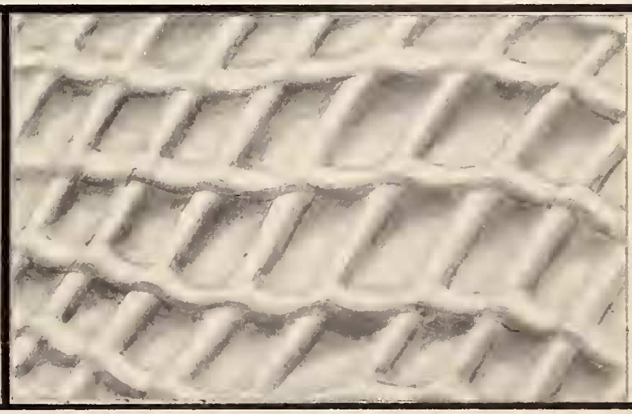

Figure 8